

6. Digital connectivity and technology

STRATEGIC OBJECTIVE Improve statewide connectivity and realise the benefits of technology

SNAPSHOT

- The NSW Government has opportunities to realise the benefits of digital connectivity and technological innovation, and ensure that NSW becomes a leader in the adoption and use of digital technology.
- Demand for high speed, reliable digital connectivity is increasing, as businesses, government and households become more reliant on connected assets and processes. However, there is inconsistent access to digital connectivity across NSW and gaps in the affordability, quality and reliability of connectivity. As improved digital connectivity is vital to NSW's economic prosperity, opportunities should be pursued to deliver the required infrastructure and levels of service across the State.
- The way in which infrastructure is used, managed, maintained and developed through technology will be determined in the future by the availability of data for analysis, decision-making, policy setting and strategic investment. We must use more data more effectively and treat data as a critical asset in its own right. Efficient collection of and access to government-held data, including the enabling spatial data infrastructure, are the keys that will unlock the benefits of technology.
- Infrastructure NSW supports the development of a centralised data repository that is accessible to everyone under open data provisions, searchable in real time and spatially enabled.
- The NSW Government's involvement in digital connectivity and technology is significant, as an owner of assets and a purchaser of around \$500 million worth of telecommunications services a year. The Government should ensure that all new and significantly upgraded infrastructure is connected or connectable by 2020 by planning for and embedding smart technology during its development.
- With technology expected to continue to disrupt most infrastructure sectors, government decision-making needs to keep up with rapid change. In particular, as the future productivity of infrastructure is likely to be greatly enhanced by the Internet of Things (IoT), a whole-of-government policy framework should be developed to guide investment in the IoT and ensure that NSW has the right systems, processes and infrastructure in place to maximise the benefits delivered by the IoT.
- Protecting assets from cyberthreats and maintaining information security are critical for the NSW Government. Risk-based approaches to cybersecurity should be strengthened and supported with the required investment. Cybersecurity risk assessments should be included as part of the assurance process for all information and communications technology (ICT) and connected infrastructure investments from 2018.

RESPONSE	Summary of key recommendations
Improve connectivity across NSW	<ul style="list-style-type: none"> Seize opportunities to improve connectivity across the State to support statewide access to uncontended 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload capacity by 2025. Conduct a stock-take of fibre optic cable networks owned or leased by NSW Government agencies. Complete the delivery of the Critical Communications Enhancement Program (CCEP). Leverage existing NSW telecommunications assets to support the statewide connectivity goals.
Invest in technology that improves productivity and social outcomes	<ul style="list-style-type: none"> Develop policies for adopting the IoT and connected infrastructure to achieve interoperability. Ensure all new and significantly upgraded infrastructure is connected or connectable, where appropriate, by 2020 through embedding smart technology during its development.
Treat data as an asset	<ul style="list-style-type: none"> Increase the use of big data and metadata to improve how infrastructure is planned, delivered, managed and operated. Develop and deliver the data ecosystem including the spatial data framework. Implement an Infrastructure Data Management Framework.
Ensure appropriate cybersecurity	<ul style="list-style-type: none"> Strengthen risk-based approaches to information and cyber security and support this with the required investment. Adopt a 'secure-by-design' approach for new initiatives and development, including the IoT and infrastructure.

6.1 Recent progress

The NSW Government has established a platform for improving service quality and efficiency through more connected infrastructure, more available data and investment in technology. Various sectors have adopted strategies for more connected digital infrastructure, including:

- NSW Digital Government Strategy
- NSW e-health Strategy
- Transport for NSW Future Technology Roadmap
- NSW Telecommunications Strategy
- NSW Government Operational Communications Strategy

- NSW Government Open Data Policy
- creation of the NSW Data Analytics Centre (DAC)
- establishment of the Government Chief Information Security Officer (GCISO) role
- ICT Strategy
- Digital Economy Industry Action Plan.

The focus of these strategies has been on improving service quality, facilitating technological innovation, enabling business and community partnerships and providing open access to State-owned infrastructure. A whole-of-government approach to connected infrastructure has not been developed.

6.2 Challenges and opportunities

6.2.1 Uncertain futures

It is hard to predict how digital connectivity and technology will develop in the future. There is uncertainty around how technology will evolve, how prevalent it will be and how trends in technology will intersect with other megatrends shaping the future of NSW.

Four possible scenarios for digital connectivity and technology in NSW

In research prepared to inform the 2018 SIS,⁶⁹ four potential future scenarios were identified. The level of connectivity required under each scenario varies, as do the benefits in terms of reduced costs of delivering services and maintaining and operating infrastructure. The four scenarios are:

- 1. Heritage** – In this scenario, digital technology has advanced but the results have only been incremental. The pathway to adoption is slow and uneven. This scenario involves the lowest level of digital impact on infrastructure planning.
- 2. Restructured** – In this scenario, technology gains have been modest but there have been considerable changes to lifestyles. A substantial number of NSW residents and visitors have opted for teleworking, online retail, telehealth and other digital services, leading to changes in mobility patterns in the near term (next five to 10 years) and eventually to changes in land use and settlement patterns.
- 3. Enabled** – In this scenario, people in NSW maintain their current mobility and settlement patterns over the coming 20 years. Today's more desirable postcodes remain attractive and people continue to endure commuter stress for trips into cities and town centres. Infrastructure is much more technologically enabled, with sensory systems, predictive analytics, automation and other digital technologies deeply embedded into infrastructure.

- 4. Renaissance** – In this scenario, infrastructure is completely reinvented and the opportunities provided by enhanced connectivity are widely adopted. Settlement patterns have been transformed, with people living in different places with different lifestyles demanding different services. At the same time, digital technologies have proven highly capable of reducing costs and improving the quality of services.⁷⁰

Infrastructure planning needs to be flexible enough to respond to each of these scenarios. The NSW Government must seek to maximise the uptake and benefits of technology. Investments in technology and service delivery should be treated in an integrated manner to take full advantage of the available opportunities.

6.2.2 Differing connectivity levels across NSW

High connectivity across NSW is fundamental to maximising the efficiencies and benefits of technology. The vast geographic area and dispersed population of NSW will be the key challenge to ensuring universal and reliable connectivity.⁷¹ The mix of connective technology across NSW includes fibre optic, copper, wireless and satellite (see Figure 14).

Some regional areas within NSW fall below the national and regional standards for digital inclusion and connectivity, as measured by the Australian Digital Inclusion Index (ADII). The ADII measures three vital dimensions of digital inclusion – access, affordability and digital ability – and shows their development over

time, across social and economic circumstances and geographic locations.⁷² Sydney scores above the national average of 56.5, with a score of 60, but rural NSW has an average score of just 51.4. Some regions have an ADII score far below the national average, such as the Murray and Murrumbidgee (50.9) and north-west NSW (51.7).⁷³

There is also evidence of increasing unmet demand for digital connectivity and dissatisfaction with current service levels across NSW. In 2017, the Telecommunications Industry Ombudsman (TIO) received over 50,000 new complaints about internet services from NSW, over 40 per cent more than in 2016.⁷⁴

6.2.3 Economic and social impacts of digital connectivity

Economic benefits of connectivity

Analysis undertaken by the OECD has identified a correlation between economic income (GDP per capita) and broadband internet speeds.⁷⁵

Without action, there is a risk that NSW's patchy connectivity will make it unattractive for investment. Australia slipped from 16th to 18th in the world on the World Economic Forum's Information Technology ranking between 2015 and 2016 (on an aggregate of 53 related indicators). This decline was partly due to the lack of affordability, with Australia ranked 57th in the world against this measure. The low levels of business adoption of ICT also impacted the country's ranking.

69 Hajkowicz et al 2017, p. 3

70 Ibid.

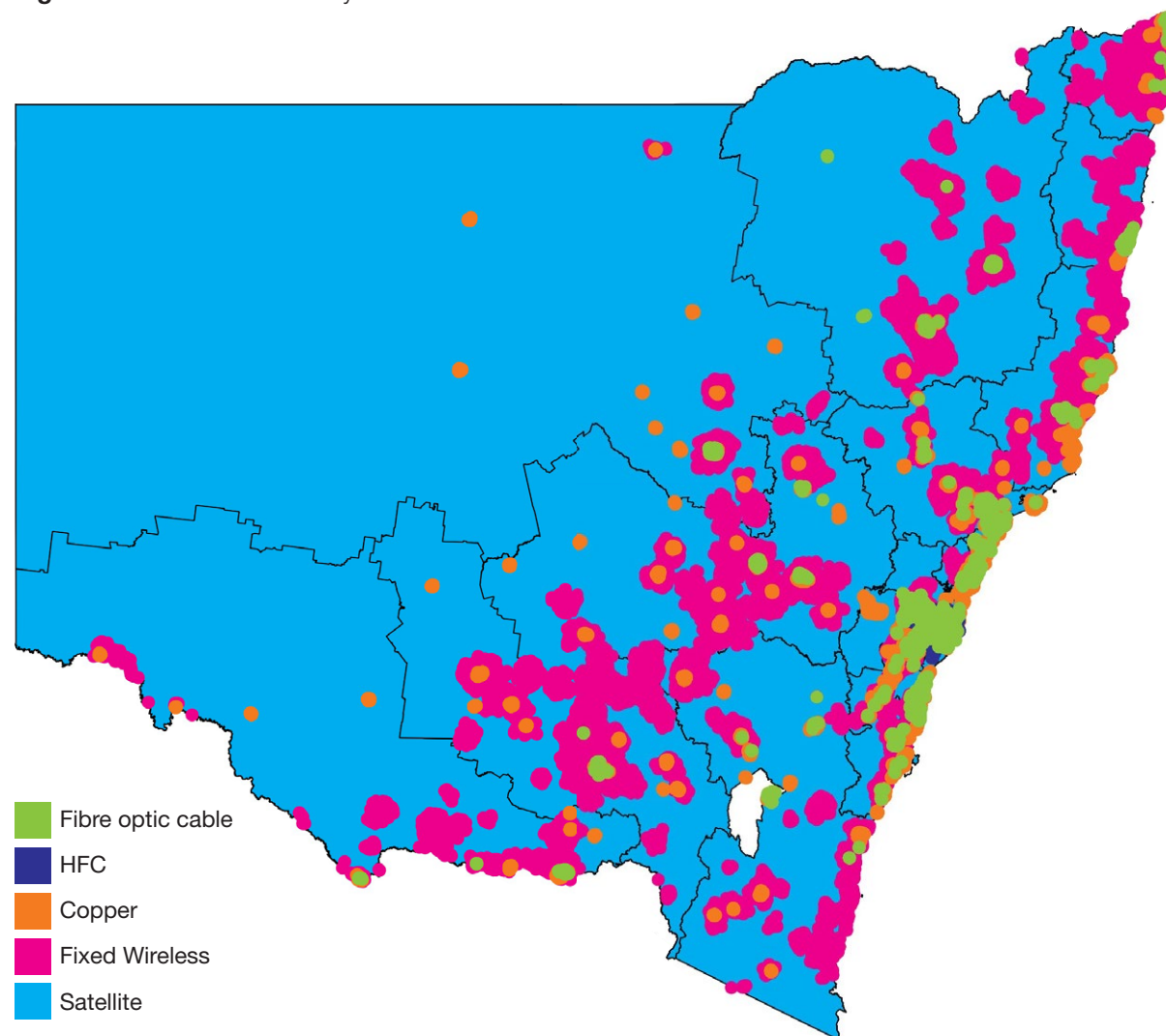
71 Ibid, p. 6

72 Thomas et al 2016, p. 6

73 Thomas et al 2017, p. 24

74 Telecommunications Industry Ombudsman 2017, p. 32

75 Hajkowicz et al 2017, p. 18 (citing OECD statistics)

Figure 14 – NSW connectivity

Source: The Grex Group 2017, *NSW Infrastructure Digital Connectivity*

Singapore is the top-ranking country, followed by Finland, Sweden, Norway and the United States.⁷⁶

Slow and unreliable internet access may hinder regional economic growth and job creation. A study of OECD countries during 1996-2007 found a 10 per cent rise in broadband penetration led to 0.9-1.5 per cent growth in annual income per capita. Another study of OECD countries during 2008-2010 found that doubling internet broadband speed increased economic growth by 0.3 per cent. Research from the United States similarly concluded that expanding broadband deployment and adoption can have a positive effect on the economy, but noted a time-lag for business benefits. While cause and effect need to be better understood, the evidence is increasing that fast and reliable internet is associated with higher rates of economic growth.⁷⁷ Improving digital connectivity is an urgent priority and is relevant to all levels of government and industry, warranting further policy development and innovative investment models.⁷⁸

Social benefits of connectivity

Investment in digital connectivity improvements in NSW, especially in areas that currently score below the ADII average, would contribute to the realisation of broader social objectives.

In 2016, the United Nations identified that the link between access to the internet, as well as ICT literacy, improved overall global education levels and social equity.⁷⁹ There is evidence that a lack of access to high-speed broadband reinforces socio-economic

⁷⁶ Ibid (citing World Economic Forum 2016)

⁷⁷ Ibid, p. 21; (citing Amelung & Nicholls 2014; BOM 2017; Muresan 2016, p. 19; McKinsey & Co 2015)

⁷⁸ Ibid, p. 8 (citing McKinsey & Co 2015)

⁷⁹ Office of the United Nations High Commissioner for Human Rights (OHCHR), Oral Revisions (30 June 2016), pp. 2-4

disadvantage, with some of the most disadvantaged areas of Australia having relatively poor connectivity.⁸⁰

Improved connectivity can support increased labour force participation rates across groups such as parents with young and school-aged children, as well as people with disabilities. High quality connectivity helps to save time and supports practices such as teleworking and flexible work.⁸¹

The Internet of Things

The Internet of Things (IoT) is made up of sensors and other devices that are connected to computing systems.⁸³ It is the global network of physical devices, home appliances, vehicles and other objects that are embedded with electronics, software, sensors and actuators, enabling these 'things' to share and exchange data to perform their functions more efficiently and effectively.

Connectivity requirements are not being met

The Productivity Commission has found that the combination of the National Broadband Network (NBN) and mobile networks is likely to meet or exceed minimum standards for universal service delivery in the short to medium term.⁸³ Analysis prepared for Infrastructure NSW indicates that over the next five to 10 years, most digital connectivity demand will be met by the market through NBN Co. and other telco providers. However, there are currently gaps in

the affordability, quality and reliability of connectivity. These gaps will widen over time and be exacerbated by expected increases in the demand for and use of data-intensive applications⁸⁴ (see Figure 15).

Areas in regional NSW served exclusively by satellite connectivity will be unable to access the same voice and high-volume data connectivity as metropolitan customers for key services such as video conferencing. Over the next five to 10 years, the demand for connectivity is expected to increase as High Definition (HD) video conferencing becomes increasingly 'business as usual' for remote working, distance education and eHealth.

Other applications that will drive the need for faster and more reliable connectivity include the large numbers of connected devices – the IOT and Machine to Machine (M2M) – as well as virtual and augmented reality to support remote working and training, distance education and eHealth. Residents and businesses may find that the connectivity required to receive basic services is unaffordable.

The digital connectivity needed to support demand for residential, business and government uses is estimated to require bandwidth beyond that provided under the NBN rollout. This means that further investment in digital connectivity infrastructure will be required beyond the rollout of the NBN rollout to meet future needs.

Fragmented procurement processes and differing agency requirements

NSW Government ICT expenditure, as a portion of total expenditure, increased from 3.23 per cent to 3.72 per cent between 2010/11 and 2015/16. According to the Department of Finance, Services and Innovation, this increase in expenditure is consistent with international benchmarks.⁸⁵ Such significant expenditure, and the market power that accompanies it, can be used more effectively to secure better outcomes for government, communities and business in NSW.

Purchasing and management of ICT services is currently undertaken on a sector and agency basis, with different levels of value being achieved by agencies. The Department of Finance, Services and Innovation is working to improve how the NSW Government purchases telecommunications services and mobile radio services, focusing on aggregating service demand and improving commercial terms for services.

80 'Three Charts on: NBN and Australia's digital divide' (21 June 2017). <https://theconversation.com/three-charts-on-the-nbn-and-australias-digital-divide-78911>

81 Hajkowicz et al 2017, pp. 19-21


82 Ibid, McKinsey & Co 2015, p. 17


83 Productivity Commission 2017a, p. 2

84 The Grex Group 2017, p. 5

85 Department of Finances, Services and Innovation 2016, p. 29

Figure 15 – Connectivity demands – residential and business

 Residential bandwidth demand (up to Mbps)					
% of premises	2013	2018	2023	2030 (estimate)	2035 (estimate)
70%	10	16	38	76	125
15%	17	31	40		
10%	23	34	42		
5%	25+	35+	43+	76+	125+

 Business bandwidth demand (up to Mbps)				
% of premises	2015	2025	2030 (estimate)	2035 (estimate)
70-75%	8	35	50-75	100+
12-16%	18	45	60-85	120+
4-8%	30	85	100-140	150+
1%	70+	100+	150+	180+

Source: Communications Chambers 2015, *The Broadband Requirements of Small Businesses in the UK*; Communications Chambers 2014, *Domestic Bandwidth Requirements in Australia, A forecast for the period 2013-2023*

Enterprise Telecommunications Optimisation Program

The Enterprise Telecommunications Optimisation Program (ETOP) has been developed to take advantage of new and emerging disruptive technologies and exploit the contestability available from more competitive supplier markets and NBN connectivity. It also embraces the fixed-mobile convergence that enables flexible and mobile working for employees.

This program builds on work already undertaken across the NSW Government to share network assets, use government buying power to achieve better unit prices, improve connectivity between government offices and increase the use of collaboration services. This program will apply across the whole-of-government and cover fixed voice, fixed data Wide Area Network (WAN) and mobile services (voice and data).

The roll-out of ETOP will:

- reduce duplication of fixed data links
- achieve commercial reform and increase value for money
- facilitate the migration away from legacy services.⁸⁶

⁸⁶ NSW Government 2015, www.finance.nsw.gov.au/ict/enterprise-telecommunications-optimisation-program-etop-faqs

The ETOP initiative does not extend to all the assets held by NSW agencies. Key exclusions include fibre optic cable in rail corridors and there is currently no NSW Government asset register of high-value digital connectivity assets such as fibre optic cable networks, spectrum and tower networks.

This issue is not unique to NSW: the Productivity Commission has recommended a national audit of existing networks, including fibre networks. A lack of publicly accessible information about these networks leads to a duplication of assets and higher costs. The Productivity Commission has noted that the extent of this problem is difficult to assess in the absence of a comprehensive telecommunications infrastructure audit.⁸⁷

Using more data, more effectively

The Productivity Commission has identified data as both an input to and an output of new technology, and as a growing resource of significant importance. Estimates of the rate of growth of data vary, although the forecast growth rate is consistently high. Lack of access to data for data-hungry businesses and government agencies looking to improve efficiency is a key barrier to technological progress. Extensive restrictions on access due to information security and privacy concerns may also be barriers to technological advances.

The Productivity Commission has argued that despite progress in states such as NSW, open access to public sector data is outstripped by developments in the United States, the UK and New Zealand, and that fundamental reform is needed to ensure that Australia is not left behind.⁸⁸

Restrictions on access to public sector data will become increasingly debilitating as the number of connected devices increases and as the IoT becomes more prevalent. Vast amounts of data exist but are not accessed or fully exploited, sacrificing opportunities to drive value through increasingly sophisticated applications.⁸⁹

In a business climate where data is a competitive currency, resources such as the unstructured and unexplored data available through the web may create new business and economic opportunities if these sources can be harnessed to develop marketable products or service offerings.⁹⁰

Information security and cybersecurity is critically important

As infrastructure becomes more connected, and as more services are delivered digitally and our reliance on analytics and data increases, cybersecurity and the protection of data assets will require an increased focus. Cyberattacks against Australia are most likely to be directed at high-value targets including critical infrastructure.⁹¹

The national Computer Emergency Response Team (CERT) is the main point of contact for cybersecurity issues affecting major Australian businesses, including the owners and operators of Australia's critical infrastructure and other systems of national interest.⁹² CERT has found that the energy and communication sectors were the most frequent targets of cyberattacks in 2016. Given that ownership of infrastructure in

Australia is divided between the public and private sector, and many networks, such as communication, transport and electricity infrastructure, span state boundaries, NSW's response will need to coordinate with national approaches. Appropriate governance and investment in cybersecurity will be required to achieve the benefits of technology and connectivity.⁹³

6.3 Response

The NSW Government will have a role in:

- building infrastructure to support connectivity
- setting appropriate standards and policies for the use of technology
- making data more open and available
- efficiently purchasing telecommunications services
- ensuring high cybersecurity and information security standards.

The NSW Government's role should be to enable the benefits of increased connectivity to be realised, while mitigating the risks that may accompany new technology.⁹⁴

6.3.1 Improve connectivity across NSW

In Infrastructure NSW's view, the NSW Government should set connectivity targets for the State that will support economic development and digital access to services. These targets should reflect the data demands of the applications needed to support the modern economy and the needs of businesses, government and residential users. Access at all

87 Productivity Commission 2017b, p. 120

88 Productivity Commission 2016, pp. 12-33

89 McKinsey Global Institute 2015, p. 4

90 Deloitte 2017, pp. 21-22

91 Hajkowicz et al 2017; Australian Cyber Security Centre 2016

92 Computer Emergency Response Team (CERT) Australia 2017

93 Hajkowicz et al 2017, pp. 32-37; Centre for International Futures 2015

94 Ibid, pp. 32-34

times (peak and off peak) to connectivity of 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload by 2025 can help to position NSW as a leader for business and the delivery of government services.

Given NSW's size, and the cost of digital connectivity infrastructure,⁹⁵ the most cost-effective approach will be to leverage assets from the NSW and Commonwealth Governments to support overall improvements to connectivity. The Commonwealth Government has provided \$29.5 billion in equity and a loan on commercial terms of up to \$19.5 billion to NBN Co. for the delivery of the NBN.⁹⁶ This scale of investment underlines the magnitude of the challenge of providing high-speed connectivity to Australian residences and businesses via fixed and wireless broadband technologies. Countries such as Singapore and the Netherlands have been able to achieve high global rankings on digital connectivity due to their small size and high population densities. Countries such as Australia and Canada struggle by comparison.⁹⁷

Infrastructure NSW has identified opportunities for government agencies to partner with telcos to pursue connectivity improvements. These partnerships will build on current expenditure and existing programs including the ETOP and the Critical Communications Enhancement Program (CCEP) (see breakout box).

Given the statewide reach of these programs and the extensive asset base held by the NSW Telco Authority, these assets can be harnessed to improve

digital connectivity in some regional areas by adding fixed wireless connectivity to existing and new Telco Authority towers.

Connectivity standards are also being considered as part of the overall regulatory system for communications as part of the Commonwealth Government's Telecommunications Reform Package. The service standard proposed in these reforms requires peak speeds of 25Mbps download and 5Mbps upload capacity from broadband connectivity providers.⁹⁸

The NSW Government has established the \$50 million Connecting Country Communities program to invest in communications infrastructure and deliver improved regional voice and data connectivity. This fund will be used to build and upgrade mobile base stations and connect businesses to global markets and schools with innovative learning resources.¹⁰⁰

Infrastructure NSW's recommendations propose a better coordinated approach that will leverage existing investments, assets and purchasing power to improve connectivity, especially in regional NSW.

Critical Communications Enhancement Program

The Critical Communications Enhancement Program (CCEP) is delivering an enhanced Government Radio Network (GRN) to improve emergency and day-to-day operational communications for NSW Government agencies, including public safety, law enforcement and essential services.

The CCEP will consolidate the large number of radio assets owned and operated by government agencies to enhance the NSW Telco Authority's existing network. It will increase the level of shared coverage available to NSW Government agencies and essential services from less than 35 per cent at present to over 80 per cent of the state. Coverage in urban areas will also improve from 96 per cent to close to 100 per cent. Emergency and day-to-day operational communications will benefit from the network capacity improvements.

The enhanced network will support network users to more easily share information – interoperability – and coordinate responses to critical incidents, leading to better outcomes for frontline personnel and the NSW community.

The shared vision for the future of operational communications is for seamless, robust communication to be available to NSW Government agencies and essential services. Moving from many independent agency networks to one single, shared platform for operational communications (as delivered by the CCEP) is key to achieving this outcome. It also paves the way for the adoption of new technologies such as public safety mobile broadband.⁹⁹

⁹⁵ Ibid.

⁹⁶ Commonwealth Treasury 2017, pp. 3-18

⁹⁷ Hajkowicz et al 2017, pp. 20-21

⁹⁸ NSW Telco Authority, <http://telco.nsw.gov.au/ccep/ccep-home>

⁹⁹ NSW Telco Authority

¹⁰⁰ NSW Department of Premier and Cabinet 2017

Recommendation 23

Infrastructure NSW recommends that the Connecting Country Communities program be used to improve connectivity in regional NSW and support access to uncontended 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload by 2025.

Recommendation 24

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead a stock-take of all fibre networks owned or managed by the NSW Government during 2018 and establish a fibre optic cable network database.

Recommendation 25

Infrastructure NSW recommends that the Department of Finance, Services and Innovation identify opportunities to leverage NSW Government-owned telecommunications assets to improve statewide connectivity in partnership with the telecommunications industry. These assets include towers, fibre optic cable networks and buildings, as well as expenditure on telecommunications services.

Recommendation 26

Infrastructure NSW recommends that the rollout of the Critical Communications Enhancement Program be completed and funding provided to the NSW Telco Authority to deliver the required infrastructure.

6.3.2 Recognising the role of data in the digital future

Policy on infrastructure data should be focused on achieving the right balance between protecting critical infrastructure and safeguarding privacy, and facilitating access to and management of data. Consistent with the recommendations of the NSW Chief Scientist and Engineer in a review of coal seam gas activities in NSW, Infrastructure NSW supports the development of a centralised data system that is accessible by everyone under open data provisions, searchable in real-time and spatially enabled.¹⁰¹

The NSW Government's Digital Strategy recognises that usable, accessible data that enables insights and informs government decisions is a critically important asset.¹⁰²

Using and managing data

Increasingly, smart ICT is being used in the infrastructure sector, with a proliferation of new ways to plan and operate infrastructure improving how services are delivered.

Smart ICT, such as sensors, provides information on the performance of infrastructure systems. As smart ICT is deployed across the State's infrastructure network, infrastructure-related data will be almost as important as the infrastructure asset itself. It will contain real-time performance information, including data on customer use. This rich information can be used to build evidence-based, data-driven models to better plan infrastructure for regional NSW and Greater Sydney and to operate infrastructure more efficiently and effectively.

An Infrastructure Data Management Framework would ensure that NSW has a coordinated, shared, standardised and trusted framework to harness infrastructure data to better plan and operate the State's infrastructure systems. It would provide governance for the continuous collection, curation and sharing of the State's infrastructure data. It would need to align with the Bureau of Infrastructure's National Data Collection and Dissemination Plan, which was prepared for the Commonwealth Government and focuses on transport data.

Established legislative and policy settings enable open access to government information and data.¹⁰³ Once infrastructure-related data is collected, it should be made open to the private sector, enabling deeper analytics to improve the function and operation of infrastructure and services, and alternative uses that can create business development and growth opportunities.

¹⁰¹ NSW Chief Scientist and Engineer 2014, p. 13

¹⁰² NSW Data Analytics Centre 2016, <https://www.finance.nsw.gov.au/ict/nsw-data-analytics-centre>

¹⁰³ Department of Finance, Services and Innovation 2016

Establishing the Data Analytics Centre

The creation of the NSW Data Analytics Centre (DAC) and the passing of the *Data Sharing (Government Sector) Act 2015*, created a central point for coordinating data sharing initiatives within the NSW Government. It identifies a group to coordinate activities to provide a whole-of-government view of service delivery and overcome the challenges faced by individual cross-agency data sharing projects.

The ongoing success of the DAC will require appropriate use and interpretation of data, managing unintended consequences of sharing data or accidental release of sensitive data, as well as adhering to privacy legislation. Frameworks for trusted data sharing will be needed.

Recommendation 27

Infrastructure NSW recommends that by the end of 2020 the Department of Finance, Services and Innovation develop and implement an Infrastructure Data Management Framework that incorporates access to open data, is searchable in real time and is spatially enabled to support market innovation and smart asset management with sector infrastructure experts.

6.3.3 Considering data as an asset

Digital connectivity and future technological advances can improve how we build infrastructure as well as improving asset utilisation and efficiency. The NSW

Government needs to consider data as an asset, and invest in spatial data and management as the supporting framework to optimise infrastructure networks.

Increasingly, infrastructure will be planned, delivered or operated using digital models. The development of a digital model containing 3D data sources and detailed specific information about sites (such as maintenance requirements, and accurate condition assessments) can help inform planning for future infrastructure and maintenance of current infrastructure.

The physical underpinning for digital modelling includes the sensors that collect information, the devices that process it, the internet that communicates it and autonomous devices that act on it.

The digital model will also require policies to govern, manage, distribute and organise data. These policies should recognise the importance of accurate, consistent and available data. Spatial data should include location coordinates of infrastructure assets and places, the measurement of distance and calculation of area. The spatial data should also cover the physical environment, including property, roads, addresses, administrative boundaries, hydrography, elevation, land cover, imagery, place names and positioning. Without a foundational spatial data framework in place, access to the benefits of digital engineering will be limited. Ongoing investment in further developing this framework is necessary to underpin future advances toward virtual 3D modelling and the increasing importance of access to Digital Engineering (DE).

As the NSW Government invests in building new infrastructure, it has opportunities to create legacy assets from information resources. Increasing and

standardising the use of DE techniques, including BIM, can reduce the cost of construction. BIM is an intelligent 3D model-based process that gives architects, engineers and construction professionals the tools to best plan, design, construct and manage buildings and infrastructure.¹⁰⁴

Foundational Spatial Data Framework

Foundational spatial data is the ‘authoritative geographic information’ that underpins, or can add significant value to, any other information. It supports evidence-based decisions across government, industry and the community.¹⁰⁵

The NSW Government has a Foundation Spatial Data Framework (FSDF) that, along with standards for time, currency and the alphabet, provides the basis for a common evidence base that enables society to function.

The FSDF is not as well-embedded as the other units of measurement and is less regulated and reliable. However, measuring and describing the physical world is more complex than measuring or describing time or currency. Considerable resources are required to standardise spatial measurement and locations to bring the FSDF to the same standard as time and currency.

As we move toward an increasingly online and connected world, it will become even more important that places, distances or areas are described using a clear framework.¹⁰⁶

¹⁰⁴ Autodesk 2017, <https://www.autodesk.com/solutions/bim>

¹⁰⁵ The Australian and New Zealand Foundation Spatial Data Framework (FNZFSDF) 2015, p. 1

¹⁰⁶ NSW Foundation Spatial Data Framework 2015

DE has made it possible to create detailed, data-rich, virtual models of everything surveyed, designed and delivered. These models can be re-used and leveraged to unlock benefits in areas such as infrastructure operations and maintenance, drawing on advanced information systems, automated systems, surveillance drones and real-time monitoring.

Given the range of infrastructure the NSW Government owns and is currently building, investing in DE now will improve asset management in the near term as well as for future investments. DE has been used for a number of projects in NSW and elsewhere, including the development of Barangaroo and Wynyard Walk, the Royal Adelaide Hospital Project, Regional Rail Link in Victoria and the Perth Children's Hospital and Perth Stadium.

The UK is leading the world in the adoption of DE, having run campaigns to ensure greater awareness and use of DE among government agencies. The adoption of DE in the UK has coincided with cost reductions. Some estimates value the potential worldwide benefits of digitisation in the non-residential construction sector to be over a trillion dollars annually during the construction phase and half a trillion dollars in the operations phase.¹⁰⁷

Recommendation 28

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a data infrastructure ecosystem, starting with the Foundation Spatial Data Framework, to access the future benefits of digital mapping and modelling of infrastructure.

¹⁰⁷ The Boston Consulting Group 2016, p. 3

Recommendation 29

Infrastructure NSW recommends that the Department of Finance, Services and Innovation prepare a business case for upgrading the Foundation Spatial Data Framework from a map to a model (a real-time 3D model of the physical environment).

Virtual Singapore

Digital twin technology is an option being used in Singapore, with the completion of Virtual Singapore expected in 2018. This model is expected to enable sophisticated analysis and coordination amongst many industries, particularly through its ability to help planners test concepts and prospective services before implementation.

Ultimately, the model will allow planners to digitally trial their ideas and pre-empt any problems before the implementation stage. This digital technology can improve real-time asset management, enable stress testing of infrastructure decisions and better integrate infrastructure networks.¹⁰⁸

Virtual Singapore will enable:

- virtual experimentation
- validation of concepts for service improvements
- more detailed assessment of demand and movement for transport and parks
- future research applications.¹⁰⁹

¹⁰⁸ National Research Foundation (Singapore) 2017

¹⁰⁹ Ibid.

6.3.4 Enabling connected infrastructure networks

The NSW Government can help to create an environment that is conducive to technological innovation and connected infrastructure networks by developing policies for connected infrastructure and the IoT. In doing so, the Government should aim to encourage and support innovation through effective and proportionate regulation.

Connected infrastructure

Where possible, new infrastructure should incorporate device connectivity, sensors and computing power. Large increases in M2M connectivity are forecast as the availability of connected infrastructure increases and the cost of enabling infrastructure such as sensors falls. The NSW Government's role, as an infrastructure owner, is to set the framework that allows the benefits of this infrastructure to be realised. For example, governments can facilitate the development of smart cities through integrated planning that embeds connectivity into new infrastructure. The proliferation of smart devices means that the contemporary city is now a data generator. By 2020, cities globally will include 10 billion 'smart objects'. Consumer demand for smart home devices will also be a major driver: the European Commission expects that by 2020, 72 per cent of European Union consumers will have smart electricity meters installed in their homes and 40 per cent will have smart gas meters. As the volume of data generated by cities increases, so too does the importance of data in city planning frameworks. For instance, transport planning decisions are increasingly able to draw on the data collected by smart ticketing systems such as Opal.¹¹⁰

¹¹⁰ Hajkowicz et al 2017 (citing Rathore, Ahmad, Paul, & Rho 2016, p. 12)

Smart cities

A city is smart when investments in human and social capital, traditional infrastructure and disruptive technologies fuel sustainable economic growth and a high quality of life, with wise management of natural resources, through participatory governance.¹¹¹

'Smart cities' use innovative solutions to address challenges related to urbanisation and sustainability. Smart city initiatives fall broadly into two categories:

- those that reduce resource use and improve and maximise efficient use of resources
- those that add context and a user experience that helps cities or towns do something new or better.¹¹²

Within NSW, local governments are adopting smart city strategies to improve liveability and sustainability. For example, the *Newcastle Smart City Strategy 2017-2021* aims to improve operational efficiency,

better service local community needs and stimulate economic development activity. Projects underway in the city centre include smart parking, free public Wi-Fi, transport network upgrades, including on-demand buses, and public domain upgrades.¹¹³

The Committee for Sydney suggests that "put simply, promoting open data, effective data governance and uniform standards to promote interoperability and value creation...are the building blocks of a smart city".¹¹⁴

Digital technologies may reduce, or even remove, the need for some types of infrastructure: teleworking, online education and online retail could reduce commuter pressure on roads at peak times.

The ability of government to access and use sensors will increase as these become smaller, smarter, self-powering and cheaper. As sensors and related systems develop, they will better detect, capture and transfer masses of information.¹¹⁵ Cheaper, more powerful technologies are likely to create new opportunities for innovation and digital business¹¹⁶ and to enable the control and automation of infrastructure at a more granular level.

Smart city opportunities for the NSW Government to explore include DE, incorporating smart technology into new infrastructure and setting governance and policy frameworks that encourage collaboration to realise the full benefits of interoperability. The benefits

of data sharing, digital connectivity requirements in urban design and planning, and applying smart cities principles to natural resource management should also be areas of focus across NSW. Regional areas are likely to be ideal test zones and locations for pilot initiatives and trial sites.

Recommendation 30

Infrastructure NSW recommends that the NSW Government develop a Smart Cities Strategy and program business case during 2018 to identify opportunities to deliver better services through collaboration and embracing the benefits of technology for infrastructure and public services.

6.3.5 Enabling the IoT

The future productivity of infrastructure will be greatly enhanced by the IoT. A survey of 1,100 Australian businesses by Vodafone in 2016 reported that 63 per cent of businesses are seeing a positive return on investment from IoT projects, up from 59 per cent in

2015. Another report by General Electric estimates that over the coming 15 years the 'industrial internet' could generate savings of US\$30 billion for aviation, US\$63 billion in healthcare cost reductions, US\$27 billion via more efficient rail freight movements and US\$90 billion through reductions in capital expenditure in the oil and gas sector globally. Numerous technology companies are investing heavily in IoT capabilities and have expectations of a growing marketplace.

It will be important to ensure that the right systems, processes and policies are in place to support adoption of the IoT. The McKinsey Global Institute argues that the benefits of the IoT could be more than US\$11 billion by 2025, and that interoperability accounts for an average of 40 per cent of the potential benefits. Similarly, the Productivity Commission argues that standards will play an important role in facilitating the adoption of new technologies and that this is particularly relevant for digital technologies. The Productivity Commission recommends that standards should be outcomes-focused and not overly complex or prescriptive. Given these trends, NSW needs to ensure that appropriate standards exist to 'future proof' the infrastructure it owns.

¹¹¹ Deloitte 2015, p. 14

¹¹² Committee for Sydney 2017, p. 13

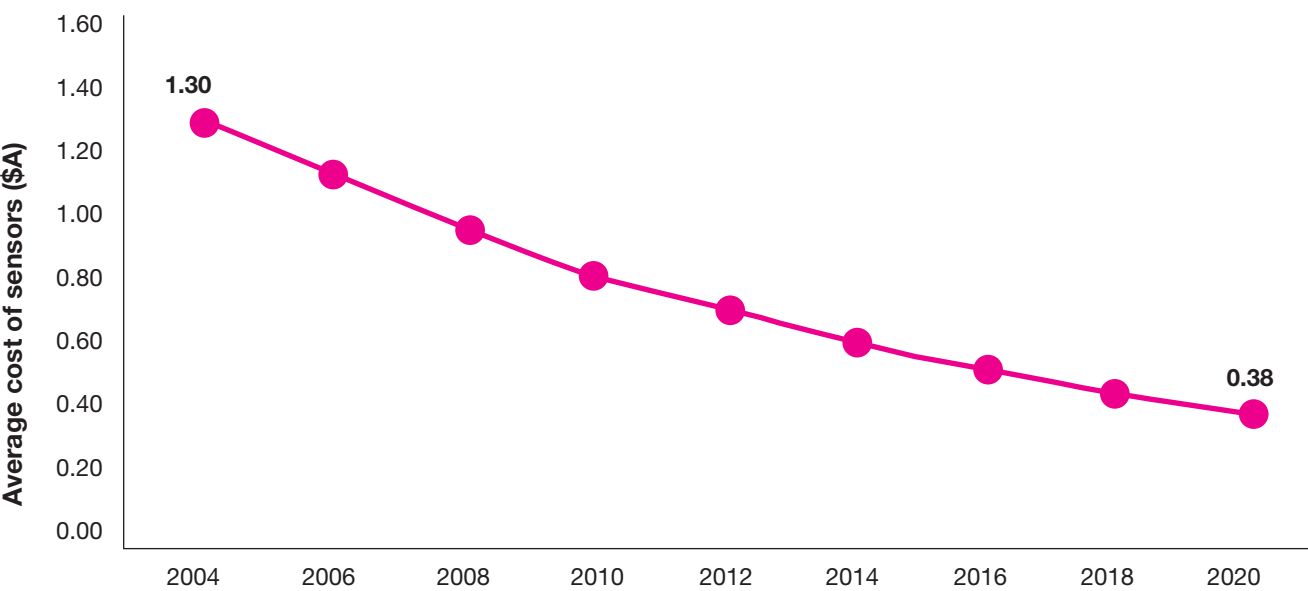
¹¹³ Newcastle City Council 2017, p. 19

¹¹⁴ Committee for Sydney, 2017, p. 11

¹¹⁵ Ibid, p. 21, (citing Goldman Sachs 2014)

¹¹⁶ Ibid.

Figure 16 – The declining average costs of sensors deployed onto the IoT



Source: Goldman Sachs 2014, *The Internet of Things: Making Sense of the Next Megatrend* (as cited by Hajkowicz et. al 2017, *Digital futures – exploring the future impacts of digital technology on the New South Wales infrastructure system*)

Recommendation 31

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a whole-of-government policy framework to guide investment in the Internet of Things (IoT) and connected infrastructure to maximise the benefits and manage the potential risks of connected infrastructure.

Recommendation 32

Infrastructure NSW recommends that the Department of Finance, Services and Innovation leads the development of a whole-of-government policy that sets the requirements for smart technology to be embedded in all new and significantly upgraded infrastructure from 2020 onwards.

6.3.6 Managing the risks of cybersecurity and information security

The NSW Government should continue to adopt a risk-based approach to information and cybersecurity connected to global best practice and national policy directions. It should invest in ensuring that there is an appropriate focus on information and cybersecurity in all projects, as well as in education and training, to increase the security awareness of infrastructure owners and operators.

A risk-based approach is consistent with recommendations of the Productivity Commission. Public confidence in the security of online systems is essential to realising the potential of the digital economy, but public cybersecurity investment will need to be proportionate and deliver a net benefit to the community.¹¹⁷

The NSW Government is increasing its cybersecurity capability with the appointment of a Government Chief Information Security Officer (GCISO) to work across agencies and consult with industry leaders and research groups to ensure an effective and collaborative approach to cybersecurity. The GCISO will need to consider a wide range of issues, including preparedness, prevention, detection, response and recovery, and coordinate an agreed position on these. The GCISO’s scope of work will include managing relationships with the State-Owned Corporations that manage much of NSW’s infrastructure and overseeing the development of information and cybersecurity management and governance arrangements for NSW’s infrastructure networks.

¹¹⁷ Ibid, pp. 112-120

As investments are made in more connected and enabled infrastructure, the Government's capital decision-making process must start to incorporate information and cybersecurity at all stages. Such safeguards will ensure that appropriate public safety, data integrity and privacy standards are being maintained.

Recommendation 33

Infrastructure NSW recommends that the existing risk-based approach to information and cyber security and support is strengthened under the direction of the Government Chief Information Security Officer in 2018, with appropriate investment including whole-of-government governance and coordination.

Recommendation 34

Infrastructure NSW recommends that from 2018, cybersecurity risk assessments be included as part of the assurance process for all ICT and connected infrastructure investments, in accordance with the risk framework developed by the Department of Finance, Services and Innovation.

Recommendation 35

Infrastructure NSW recommends that a secure-by-design approach for new initiatives and development be adopted in accordance with standards set by the Government Chief Information Security Officer, including the IoT and connected infrastructure, and that this be included in the connected infrastructure policy framework by 2020.